Semi-Annual Report on NASA Grant NAGW5-1097: Modeling of the Atmosphere-Magnetosphere-Ionosphere System.

1 May 1994 to 31 October 1994

During the period covered by this report work has proceeded on the following continuing projects:

- Analysis of spectral auroral images from high altitude satellite. The goal of this analysis is the interpretation of images from the VIS, UVI, and PIXIE instruments on POLAR. Tests are under way to evaluate our analysis method with images from the Dynamics Explorer satellite (visible and UV images) and the UARS satellite (X-ray images). Observed spectral brightness is interpreted in terms of electron precipitation. This precipitation is used in turn to obtain ionospheric parameters by means of an auroral model. The obtained conductances are combined on a global scale with other measurements, including incoherent scatter radar observations, *in situ* particle observations, ground based magnetometer data, and other available data. The tool for this data assimilation is the AMIE (Assimilative Modeling of Ionospheric Electrodynamics) procedure.

- A theoretical paper on a full kinetic treatment of the transition from collision dominated transport to collisionless flow of light ions has been completed and submitted to *J. Geophys. Res.* A copy of the abstract is appended. The theory that is presented in this paper finds application in studies of the helium escape from the Earth's atmosphere and in studies of the polar wind.

- A paper entitled "Modeling of the atmosphere-magnetosphere-ionosphere system: MAMI" was finalized and accepted for publication in the GGS/ISTP special issue of *Space Science Review.*

- Software development to access key parameters from the ISTP/GGS missions is under way. We have installed and modified software provided by the SPOF, and have started to develop software which is tailored to the requirements of the image analysis.

- The ISTP/GGS Science Team Meeting held in Baltimore (May 23 and 26) was attended by M. Rees.

Helium Escape from the Earth's Atmosphere: The ion outflow mechanism NDB

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Abstract

We have studied the escape of helium from the terrestrial atmosphere by outflowing He^+ ions along geomagnetic field lines that are open to the interplanetary medium. Coulomb collisions with the background ions are treated rigorously in the Fokker-Planck transport equation which is adopted in the transition region between the collision dominated low altitude regime (treated by moment equations) and the collisionless regime at very high altitudes. Unlike previous treatments of the ion escape problem, our approach avoids assumptions of boundary conditions and of truncation of moments. We show that neglecting the heat flow term in the momentum equation yields incorrect He^+ densities, drift speeds and fluxes. While the densities and drift speeds are sensitive to the velocity distribution of the ions, the flux is a robust quantity that depends primarily on the altitude of the transition between the region of chemical equilibrium and no charge exchange loss. A good estimate of the He^+ escape flux can be obtained from the column production rate above this transition altitude. We have computed the global escape flux for a range of cutoff latitudes of open field lines. We find that for solar maximum production rates the polar ion transport mechanism is capable of balancing the terrestrial outgassing rate of He, but for solar minimum conditions the process falls short by a factor of five or six.

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Modeling of the Atmosphere-Magnetosphere-Ionosphere System MAMI

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ABSTRACT

The effects on the terrestrial atmosphere and ionosphere of energy and momentum sources of magnetospheric origin are investigated theoretically. Parameters measured by instruments on board the GGS spacecraft and by the GGS ground-based networks are used as inputs to the models that quantify the magnetosphere-ionosphere-thermosphere coupling. Images of the aurora acquired at ultraviolet, visible and x-ray wavelengths by instruments on board the POLAR spacecraft are particularly useful in this investigation by yielding good spatial coverage and high time resolution of the aurora.